JOURNAL BEARING ARRANGEMENT

DESCRIPTION

Technical Field

The invention relates to journals for highly loaded journal bearings, and in particular to a planet gear bearing arrangement for a planetary gear system.

Background of the Invention

Planetary gear systems have been used for aircraft either in the dual power mode or with the ring fixed and the planetary gear system used for speed reduction. In aircraft gas turbine engines the engine is rotating at high speed and used to directly drive the sun gear. High speed and high loads are imposed on this system where the system is used to drive the fan.

A planetary gear system has a planet gear carrier supporting the planet gears and transmitting the load from the plurality of planet gears. It is known that flexibility of the planet gear support is necessary to contribute to load equalization between the various planet gears.

Each planet gear includes an internal journal bearing surface and a pin around which this bearing rotates. The bearing surface is between the journal bearing and the pin. Deflection of the pin leads to distortion of the bearing surface and increasing the required clearance. A balance is required between a minimum clearance and excessive clearance in order for the bearing to function properly. Too small a clearance results in excessive film temperature, and too large a clearance will result in inadequate film thickness.

The load on the planet bearing which must be transferred through the pin to the carrier includes the sun gear force plus the ring gear force and the G-field centrifugal force. A larger pin would stiffen the bearing surface, but this would lead to higher weight and also higher G-forces. It would also stiffen the arrangement and deter any load sharing capability between the various planet gears. A smaller diameter pin would facilitate load sharing and reduce the G-forces, but it imposes bending upon the bearing surface.

It would be desirable to have an arrangement which is relatively light, facilitates load sharing, but maintains a minimum longitudinal deviation of the bearing surface.

SUMMARY OF THE INVENTION

A plurality of planet gears are supported from a planet carrier and located between a sun gear and a ring gear. Within each planet gear is a bearing secured to the gear portion and a pin around which the bearing rotates. This pin is then supported in the planet carrier.

Each pin has a cylindrical central axially extending portion which is supported in the carrier. A cylindrical outer portion is contiguous or integral with the central portion at an inboard merged zone, and this outer portion has cylindrical cantilever sections extending outboard from the merged zone in both directions. The cantilever sections are concentrically surrounding and spaced from the central portion outboard of the merged zone. The load applied through an oil film against the pin deflects the central portion with a bend radius toward the load and deflects the cantilever sections with the bend radius away from the load. The material and geometry of these portions are selected such that under the expected load distribution the deflected surface under load approaches an axial straight line.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an axial sectional view through a planetary gear assembly;

FIG. **2** is a longitudinal view through a planet gear; and

FIG. **3** is a longitudinal section through the pin.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A planetary gear assembly **10** includes a ring gear **12** which is rigidly supported on support **14**. Sun gear **16** is centrally located within the ring gear. Five planet gears **18** are arranged to mesh with the sun gear and the ring gear.

Each planet gear has an outer gear section **20** with a bearing **22** fitted inside. The gear is supported on pin **24** which in turn is then supported by the planet gear carrier **26**.

The sun gear **16** is rotated in the direction **28** applying force **30** against the planet gear. This causes the planet gear **18** to rotate in the direction of arrow **32** because of the force **34** imposed by the ring gear. The planet gears and the planet gear carrier **26** move in the direction **36**.

Centrifugal force imposes a G-force **38** on the planet gear. The combination of these forces results in a resultant force **40** transferred from the planet gear bearing **22** to the pin **24**, and thence to the carrier **26**.

As shown in FIG. **2**, a central drive shaft **38** may be used to engage and rotate sun gear **16**. Gear teeth **41** are located between the sun gear and the planet gear **18**. Planet bearing **22** is fit tightly within the internal circumference of the planet gear.

An oil film is located between the bearing surface **42** of bearing **22** and the surface **44** of the pin **24**. A cylindrical axially extending central portion **46** of the pin is end supported within carrier **26**. A cylindrical outer portion **48** is integral with the central portion **46** at the inboard located merged zone **50**. Cylindrical cantilever sections **52** extend outboard from the merged location in both directions. These cantilever sections concentrically surround the central portion **46** outboard of the merged location with grooves **54** providing space therebetween.

Also shown in this view is oil flow supply opening **56** supplying oil to oil distribution recess **58** through opening **60**.

The configuration of the pin is more specifically addressed with respect to the illustration of FIG. **3**. Considering for discussion purposes the oil film load applied to the top, a conventional cylinder used as the pin would deflect downwardly. If the ends were freely supported, it would deflect the maximum amount being horizontal at the centerpoint. The outside edge of the pin in contact with the bearing would similarly reflect this pattern resulting in a substantial linear mismatch between the pin surface and the bearing.

If the ends were rigidly supported, there would be less ultimate deflection with the pin forming a sinuous type curve. While there is less deflection of the outer surface, it still results in a substantial nonlinear result. Furthermore, even if the end connections were rigid, a reasonably sized carrier structure would deflect whereby the result approaches that of the free end support.